

**UNITED
NATIONS**



**Economic and Social
Council**

Distr.
GENERAL

CEIP/S3.RR/2008/SWE
19/02/2009

ENGLISH ONLY

**Report for the Stage 3 in-depth review of emission
inventories submitted under the UNECE LRTAP
Convention and EU National Emissions Ceilings
Directive for:**

SWEDEN

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INTRODUCTION

1. The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document '*Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols*'⁽¹⁾ – hereafter referred to as the 'Methods and Procedures' document.
2. This annual review has concentrated on SO₂, NO_x, NMVOC, NH₃, PM₁₀ and PM_{2.5} for the time series years 1990 – 2006 reflecting current priorities from the EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP).
3. This report covers the stage 3 centralised review of the UNECE LRTAP Convention and EU NEC Directive inventories of Sweden, coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 6th October 2008 to 10th October 2008 in Copenhagen, Denmark, and was hosted by the European Environment Agency (EEA). The following team of nominated experts from the roster of experts performed the review: generalist – Justin Goodwin (EC), Energy - Stephan Poupa (Austria) and Ole Kenneth Nielsen (Denmark), Industry - Helena Hnilicová (Czech R.), Solvents - Patrik Fauser (Denmark), Agriculture + Nature - Bernard Hyde (Ireland), Waste - Celine Gueguen (France).
4. No review findings have been included in this report for Industrial Processes as there were difficulties in completing a review of the industrial process sector due to the time demanding task and language difficulties experienced by the industrial processes expert.
5. Justin Goodwin was the lead reviewer. The review was coordinated by Katarina Marečková, (EMEP Centre on Emission Inventories and Projections - CEIP).

¹ Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols. Note by the Task Force on Emission Inventories and Projections. ECE/EB.AIR/GE.1/2007/16 <http://www.unece.org/env/documents/2007/eb/ge1/ece.eb.air.ge.1.2007.16.e.pdf>

PART A: KEY REVIEW FINDINGS

Inventory Submission

6. Sweden has the reported emissions for its Protocol base years and a time series from 1980 to 1989 for aggregated national totals for SO₂ and NO_x which is compliant with its Protocol commitments. Sweden has reported a full 1980 - 2006 (the latest year) time series for PM₁₀ and PM_{2.5} and a full 1990 - 2006 time series for the other pollutants reviewed (NO_x, SO₂, NMVOC, NH₃, CO) in NFR. Sweden also submitted a detailed IIR.

7. The CLR TAP inventory submitted by Sweden appears to be of good quality and is in general well documented in the informative inventory report (IIR). However ERT recommends improving transparency for a number of categories in the next submission. More detailed findings of the expert review team (ERT) are provided in the next sections.

Key categories

8. Sweden has compiled and presented in its IIR a level and trend Key Source Category Analysis for the following pollutants: NO_x, CO, NMVOC, SO_x, NH₃, TSP, PM₁₀ and PM_{2.5}, Pb, Cd, Hg, Dioxin and PAH1-4. All sectors have been included except sector 5B Forest and Grassland Conversion. The level assessment is performed for 1990 and 2006, and the trend assessment for 2006, using 1990 as the base year for all pollutants. The analysis is the same as that of the CEIP for NO_x. However, there are differences in a number of places for SO₂ and NH₃ (4B1a). The ERT encourages Sweden to check its key category analysis for these pollutants. Sweden reported SO₂ gridded data for 2000 and 2005, and 2005 gridded data for all protocol pollutants except HCB.

Quality

Transparency

9. The ERT recognises the level of effort undertaken by Sweden in providing an inventory with a significant level of detail to undertake a detailed review. The Swedish IIR contains good methodological descriptions and information on the emission factors used including time-series development and references for the Energy sector. However, very few of the underlying activity data are included in the IIR for energy and there is a lack of detail for certain Solvents, Agriculture and Waste Sectors. The ERT encourages Sweden to improve transparency by including in its IIR activity data for the Energy sector and the activity data, emission factors and assumptions necessary to recreate the emission estimates for the Solvents, Agriculture and Waste Sectors as presented in the detailed descriptions below.

10. In addition, the ERT encourages Sweden to improve their documentation of completeness in future IIRs.

Completeness

11. The ERT acknowledges the effort to which Sweden has gone to provide estimates of emissions for all sub-sectors and all pollutants.

12. Sweden's inventory for the pollutants reviewed is generally complete. However, there are missing sources indicated in the Energy (1A3ei Pipeline compressors reported as NE) and Waste (landfill disposal and biological treatment) sectors. In addition, there is little description in the IIR of the significance of these sources. The ERT considers that these sources have little influence on the national total but encourages Sweden to provide estimates in future submissions.

Consistency, including recalculations and time-series

13. Sweden has undertaken a number of recalculations for their 2008 submission in the energy, solvents and agriculture sectors. Detailed descriptions have been provided for the Energy and Solvents sector. However, there is insufficient detail for agriculture. The ERT encourages Sweden to provide sufficient detail in its IIR submissions on the recalculation of emission estimates for the agriculture sector.

14. The ERT noted the inconsistent time series identified by Sweden for NH₃ in the agriculture sector. The ERT encourages Sweden to review its calculation methodologies and activity data sources so as to provide a consistent approach to NH₃ emission estimates from Agriculture in future submissions.

Comparability

15. The inventory for Sweden is comparable with those of other countries as defined in the EMEP/UNECE reporting guidelines. The allocation of source categories follows the split in the EMEP/UNECE reporting Guidelines. The ERT encourages Sweden to continue with this approach to national inventory calculation.

CLRTAP/NECD comparability

16. The ERT noted that estimates provided by Sweden under LRTAP and NECD appear to be comparable. However, due to the transparency issues identified above and in other sections of the report, Sweden is encouraged to ensure that emission estimates are transparently calculated and are consistent across the time-series.

Accuracy and uncertainties

17. Sweden has not compiled uncertainty estimates for their UNECE submission. The ERT encourages Sweden to compile at least tier 1 estimates for future submissions.

Verification and quality assurance/quality control approaches

18. The ERT commends Sweden on the operation and documentation of its quality assurance/quality control (QA/QC) activities. Sweden provides specific information on verification activities and has undertaken a number of reviews within the energy, solvents and agriculture sectors.

19. All quality procedures according to the Swedish QA/QC plan (Manual for SMED's Quality System in the Air Emission Inventories) have been implemented during the work with this submission. All Tier 1 general inventory level QC procedures and some specific Tier 2 QC procedures, listed in Good Practice Guidance section 8, have been performed for the Energy, Solvents and Agriculture sectors and are documented in check-lists in the IIR. Remarks in reports from the UNFCCC and CLRTAP/NEC reviews have been carefully read and taken into account.

Follow-up to previous reviews

20. Sweden provided a response to the Stage 2 S&A report and responded to the ERT during the review week.

Areas for improvements identified by Sweden

21. Sweden have identified a number of areas of improvement in the solvents and waste sectors. These include:

- NFR 3D: a study of emissions from mercury containing products such as thermometers, fluorescent lamps, instruments, tubes and fireworks.
- Mercury EF and activity data for hospital waste
- Reviewing of the existing Hg EF from landfills
- The emission of particulates from agricultural activities.

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

Cross cutting improvements identified by the ERT

22. The ERT identifies the following cross-cutting issues for improvement:
- (a) Documentation of completeness in future IIRs.
 - (b) Improve the transparency for methods which use country specific emission factors and present the activity data used.
 - (c) Check its key category analysis for these pollutants.
 - (d) Compile at least tier 1 estimates for future submissions.
 - (e) Review its calculation methodologies and activity data sources for NH₃ emission estimates from sector 4 Agriculture and provide more detail in its IIR on the recalculation of emission estimates for the agriculture sector.
 - (f) Provide estimates in future submissions, for sources not estimated.
23. Recommended improvements relating to specific source categories are presented in the relevant sector sections of this report.

Sector specific recommendations for improvements identified by ERT

Energy and transport:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
1.A.1	Energy industries	x		
1.A.2	Manufacturing industries and construction	x		x
1.A.3	Transport	x		x
1.A.4	Commercial, Residential, Agriculture & Forestry	x		x
1.A.5	Other	x		x
1.B.1	Fugitive emissions from solid fuels	x		
1.B.2	Fugitive emissions from oil and natural gas	x		x

Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.

General recommendations on cross cutting issues.

24. The ERT noted that Sweden provides specific information on verification activities within the energy sectors. Two large studies have been carried out comparing data from the energy statistics with plant specific information. The ERT

encourages Sweden to provide further descriptions on the findings of these studies and the consequences for the inventory methods and uncertainties.

25. The documentation for the methodology and emission factors is good. However, very limited information is available on the activity data used in the energy sector. The need for detailed activity data in the IIR will be greatly reduced since Sweden indicates that the 2009 submission will be made in the new NFR template, which includes information on activity data. In some cases the activity data used does not match the published energy statistics. The ERT encourages Sweden to investigate if large discrepancies between official energy statistics and data used for inventory compilation are detected.

26. Sweden provides a very detailed description of the recalculations performed, but not all recalculations have been quantified. The major recalculations are for NO_x which is caused by new estimates for non-road vehicles and machinery, and PM and heavy metals due to a new calculation procedure for tyre and brake wear and from road abrasion. The ERT encourages Sweden to provide a full quantification of recalculations in their IIR.

Sub-Sector Specific Recommendations.

1.A.2 Industrial Combustion:- All Pollutants

27. The ERT noted a lack of clarity in the distinction between energy related emissions and process emissions. For instance emissions from cement production for some pollutants have been reported under 1A2f while others are reported in 2A1, and this is explained for some but not all pollutants in the IIR. In the NRF tables Sweden has used the notation key NA for the emissions from cement production allocated to the energy sector. The contribution from cement production to the total emission of sector 1A2f is not provided. The ERT recommends that this information be included in future reporting. The ERT recommends that, in future reporting, Sweden should produce an overview table that shows where the different pollutants are allocated. The ERT recommends that Sweden should use the notation key IE for process emissions that are included under energy or vice versa.

1.A.4.b Residential wood combustion – All pollutants

28. Sweden has recently changed emission factors for residential wood combustion, NFR sector 1A4b I which is a key source for many pollutants. Some emission factors, e.g. NMVOC, have decreased by more than 85 %. The values are substantially lower than the emission factors provided in the EMEP/Corinair Guidebook. Sweden provided additional information regarding the selection of emission factors during the review. The ERT acknowledges Sweden's effort to improve the estimates from this source and encourages Sweden to continue this effort. The ERT recommends that, in future reporting, Sweden should improve the description of the selection of emission factors for this sector in the IIR.

1.B.2.b Fugitive emissions from natural gas: – NMVOC

29. Sweden reports sector 1B2b as not occurring. In response to the ERT Sweden indicated that the emissions were included under 1A5a and that the operators claim that no fugitive losses occur. Previously Sweden had reported the emission under sector 1B2b. The ERT recommends that the emission from pressure losses be allocated to 1B2b and that the assumption that no fugitive losses occur during transmission and distribution be further checked.

1.A.3.b Road transport:- NMVOC

30. NMVOC emission from gasoline evaporation is reported as included elsewhere, but the IIR does not provide information on where this emission has been allocated. According to the information on the road transport model provided in the IIR, the evaporative emissions are calculated separately. In order to improve transparency, the ERT recommends that the emissions in the future be allocated to NFR sector 1 A 3 b v R.T., Gasoline evaporation.

Industrial Processes

31. No review findings have been included for Industrial Processes as there were difficulties in completing a review of the Industrial Process sector due to the time demanding task and language difficulties experienced by the Industrial Processes Expert.

Solvents

Review Scope

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ , & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
3.A.1	Decorative coating application	X		X (general)
3.A.2	Industrial coating application			
3.A.3	Other coating application (Please specify the sources included/excluded in the notes column to the right)			
3.B.1	Degreasing	X		X (general)
3.B.2	Dry cleaning			
3C	Chemical Products, Manufacture & Processing	X		X (general)
3.D.1	Printing	X		X (general)
3.D.2	Domestic solvent use including fungicides			
3.D.3	Other product use			
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross cutting issues

32. The ERT encourages Sweden to complete and include estimates for mercury from the planned study on mercury containing products such as thermometers, fluorescent lamps, instruments, tubes and fireworks and the use of fireworks.

33. The ERT encourages Sweden to include a list of the most important chemical and/or product groups, where such information is available.

34. The ERT encourages Sweden to explain in the IIR why double counting of substances is not a problem for the solvent sector.

35. The ERT encourages Sweden to include and document the new method developed during 2005 which uses activity data concerning solvent and other product use from the Products register hosted by the Swedish Chemicals Inspectorate, including details of all imported and manufactured chemicals and chemicals in preparations included in the Product Register, which is a primary data source in the inventory.

36. The ERT encourages Sweden to describe the methodology for estimating solvent use more comprehensively including the presentation of the activity data and emission factors used for each category on the highest possible level of detail. When there is information on specific chemicals and a user product group, it is recommended that it should be presented in the IIR and an explanation given on how this information is used in the inventory.

37. The ERT encourages Sweden to improve their documentation of completeness for the Solvents sector in future IIRs.

Agriculture.

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
4.B	Manure Management	NH ₃		
4.D	Direct Soil Emission	NH ₃		
4.G	Other	PM ₁₀ , PM _{2.5}		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross cutting issues

38. The methodological approach to NH₃ emissions for sector 4 is not fully transparent. The ERT encourages Sweden to provide more detailed descriptions in future IIRs for estimates that are based on country specific information and to ensure that all estimates can be recreated by the ERT.

39. A number of issues were raised by the ERT during the review week and Sweden was asked to respond to these questions. No response was received by the ERT either during the review week or within the timetable developed to meet the drafting of reports and transcripts. As a consequence the emission estimates for sector 4 Agriculture for Sweden could not be fully reviewed. The ERT therefore encourages Sweden to participate fully in future Stage 1, Stage 2 and Stage 3 review requests in the future review.

40. The ERT notes that, in its IIR submission, Sweden states that “NH₃ emissions for the agricultural sector for the years 1990-1994 are not directly comparable to those from 1995-2006”. Therefore the time series of emissions for this key source within the inventory is not consistent. The ERT encourages Sweden to review its calculation methodologies and activity data sources so as to provide a consistent approach to NH₃ emission estimates from sector 4 Agriculture in future submissions.

41. The ERT notes that Sweden has provided, in its IIR submission sector, specific information on QA/QC approaches for sector 4 Agriculture. The ERT encourages Sweden to continue undertaking sector specific QA/QC procedures and to continue with the process of providing this information in IIR submissions.

42. The ERT encourages Sweden to provide a clearer description of their methodological approach and to ensure correct referencing of data tables for the agriculture sector in future IIR submissions.

Sector specific recommendations

4.B Manure management:- NH₃ & PM

43. The ERT encourages Sweden to provide activity data tables with respect to emission estimates for sectors 4B.

4.B.1.a Dairy cattle

44. The ERT encourages Sweden to report dairy cows separately, rather than allocating them to other cattle, as activity data is available for dairy cattle.

4.D.1 Agricultural soils:- NH₃ & PM

45. The ERT encourages Sweden to provide activity data tables with respect to emission estimates for sectors 4D1 in particular fertilizer consumption statistics, the compounds used within the country and the level of aggregation at which emission factors are applied.

4.B.1.a Dairy cattle

46. The NH₃ inventory for sector 4 Agriculture is generally complete with the exception of sector 4B1a Dairy Cattle for which no estimates have been provided for the years 1990-1994 inclusive. Sweden reported emissions for this sector in 4B1b Other Cattle over this period even though activity data exists with regard to this source. The ERT encourages Sweden to provide a thorough description as to why this approach was taken in inventory calculations.

4.G Other - PM emissions

47. The ERT notes that Sweden undertook a recalculation of particulate emissions from sector 4G Other as part of its submissions to CLRTAP and NECD. The ERT encourages Sweden to continue to provide sufficient detail in its IIR submissions on the recalculation of emission estimates.

Waste.

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
6.A	solid waste disposal on land	NA		
6.B	waste-water handling	X		X
6.C	waste incineration	X		X
6.D	other waste (e)	X		no
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross cutting issues.

48. Waste: Emissions calculation methodologies concerning the NFR 6 sectors are very briefly described in the IIR. Activity time series and EF are not always indicated except for landfill fire estimates. Emission values cannot be calculated on the basis of data available in the IIR. References are a little confused. The ERT encourages Sweden to improve the transparency of the ERT by providing precise methodological descriptions, presenting assumptions and more detailed information concerning activity data and EF (as provided during the review).

Sector Specific Recommendations

6.A Solid waste disposal

49. The ERT encourages Sweden to explain in its IIR the reason for not calculating emissions from solid waste disposal and to attempt to calculate emissions for future submissions.

6.B Waste-water handling

50. The ERT encourages Sweden to use appropriate activity data to calculate the time series emissions from waste-water handling instead of using the same value for all years.

51. The ERT encourages Sweden to update the NH₃ emission values for instance by improving the activity time series, by taking into account the evolution of the population connected to non-collective waste-water handling systems and taking into consideration the evolution of the per capita per protein intake.

6.C Hazardous waste incineration:

52. The ERT noted that time series evolution is not justified in the report concerning NFR 6 (hazardous waste incineration). The ERT recommends Sweden to present a short explanation of these time series in the inventory report.

6.C Garden burning, landfill burning

53. The ERT encourages Sweden to explain in its IIR the reason for not calculating emissions of other pollutants from garden burning, landfill burning (only PAH and particles are estimated) and to attempt to calculate emissions for future submissions.

6.D Biological treatment of waste

54. ERT encourages Sweden to explain in its IIR the reason for not calculating emissions from biological treatment of waste and to attempt to calculate emissions for future submissions.

List of additional materials provided by the Sweden during the review

- PM ETS data.doc - Document provided by Sweden in response to question on ETS
- Small scale combustion.doc - Referenced document in the IIR provided by Sweden
- Report appendixesny.doc - Appendix to Small scale combustion.doc provided by Sweden
- Emissions from off road vehicles.doc - Document provided by Sweden
- Metanrapport.doc - Document provided by Sweden in connection to question regarding inconsistencies in Energy balance
- Appendix 27 Thermal values and Emission factors energy.xls - Spreadsheet provided by Sweden during review